

FOOD HABITS OF NESTING PRAIRIE FALCONS IN CAMPBELL COUNTY, WYOMING

JOHN R. SQUIRES, DR. STANLEY H. ANDERSON AND ROBERT OAKLEAF

ABSTRACT.—Fifteen species of prey were utilized by nesting Prairie Falcons (*Falco mexicanus*) as determined through pellet analysis. Thirteen-lined Ground Squirrels (*Spermophilus tridecemlineatus*), the most common prey, were present in 91% of the pellets, followed by Western Meadowlarks (*Sturnella neglecta*) which were present in 56% of pellets. Horned Larks (*Eremophila alpestris*) and Lark Buntings (*Calamospiza melanocorys*) were found in 23% and 12% of the pellets, respectively. Additional prey species were present in low frequencies ($\leq 5\%$). Eighty-nine percent of pellets contained both bird and mammal remains. Four percent of pellets contained only bird remains while 7% contained only mammalian remains.

The Prairie Falcon (*Falco mexicanus*) is an open-country raptor that forages on a diversity of birds and small mammals (Enderson 1962; Denton 1975; Becker 1979; Boyce 1985). Diets of nesting Prairie Falcons depend on local prey abundance. For example, some nesting Prairie Falcons forage primarily on mammalian prey (Porter et al. 1973; Ogden and Hornocker 1977), while others forage primarily on avian prey (Marti and Braun 1975; Becker 1979; Boyce 1985). Therefore, predicting falcon diets based on studies from different areas is difficult.

Our analysis of Prairie Falcon diet was part of a larger study that investigated movements and habitat-use patterns. Our objective was to determine important prey species used by a small population of nesting Prairie Falcons in northeastern Wyoming.

STUDY AREA AND METHODS

The study area located in northcentral Wyoming included the Pumpkin Butte formation, which contains 5 buttes used by a small, isolated population of nesting Prairie Falcons ($\bar{x} = 6$ pairs/yr). Average distance between occupied territories was 0.56 km, and prairies surrounding the buttes were either sagebrush (*Artemisia tridentata*) steppes or open grasslands.

Pellets and prey remains were collected at falcon eyries from 1982 through 1985. Mammalian prey were identified by examining both internal and external hair characteristics and through comparisons with specimens collected at the study site. Hair identification procedures were conducted according to those outlined by Moore et al. (1974). Avian remains in pellets were identified by comparing characteristic feather, beak, and bone fragments with the University of Wyoming's museum collection.

Pellet analysis cannot be used to directly quantify the number of prey items consumed due to several biases associated with the technique (Craighead and Craighead 1956). For example, adult falcons have been observed removing pellets and uneaten prey remains from their nest site (Fowler 1931; Wayre and Jolly 1958). Therefore, the percentage of prey items in the diet as determined through analysis of pellet and prey remains should be interpreted as an approximation of the falcon's true diet. To supple-

ment data gathered from pellet and prey remain analyses, foraging falcons were observed when possible.

Prey Abundance Indices. During 1984 and 1985, birds and small mammals were sampled on transects that were established in areas frequently used by foraging falcons. Transect sampling was used as an index of the relative abundance of prey species and to document changes in prey abundance between years. All prey-sized birds occurring along a 1.6 km, walked, belt-transect were counted. Bird transects ($N = 6$) were censused twice each summer between July 2 and July 16, at approximately 0.5 hr after sunrise.

Each small mammal transect ($N = 4$) consisted of 100 Sherman live-traps placed 10 m apart that were trapped for 2 successive days and nights. Traps were baited with a mixture of peanut butter and oats. Traps were checked approximately 1 hr after sunrise and 1 hr before sunset. All transects were sampled between 8 July and 24 July during both years.

Transect data were compared using *t*-Tests [STATISTICAL PACKAGE FOR THE SOCIAL SCIENCES (SPSS), Nie et al. 1975; $\alpha = 0.05$]. The 2 replicates of the 1984 indices were averaged and then compared to the average of 1985 indices.

RESULTS

Food Habits. A total of 243 pellets, plus prey remains from 9 eyries, were examined. At least 15 prey species were used by this population of Prairie Falcons (Table 1). Four species, Thirteen-lined Ground Squirrels (*Spermophilus tridecemlineatus*), Western Meadowlarks (*Sturnella neglecta*), Horned Larks (*Eremophila alpestris*) and Lark Buntings (*Calamospiza melanocorys*) were important prey species during each year of the study (Table 2). Most of the remaining prey species occurred in pellets in low frequencies ($\leq 5\%$). Eighty-nine percent of the pellets contained both bird and mammal remains. Four percent of the pellets contained only bird remains while 7% contained only mammalian remains.

Foraging Behavior. Foraging falcons used low, flushing-type flights when hunting. Typically, fal-

Table 1. Food items in pellets of Prairie Falcons nesting in Campbell County, Wyoming, 1982–85.

PREY SPECIES	NUMBER OF PELLETS CONTAINING PREY ITEM	PER-CENT PELLETS WITH PREY ITEM
Mammals		
13-lined ground squirrel (<i>Spermophilus tridecemlineatus</i>)	221	91
Least Chipmunk (<i>Eutamias minimus</i>)	7	3
Leporidae spp.	8	3
Unknown mammal	2	1
Mule Deer (<i>Odocoileus hemionus</i>)	1	<1
Birds		
Western Meadowlark (<i>Sturnella neglecta</i>)	135	56
Horned Lark (<i>Eremophila alpestris</i>)	55	23
Unknown passerine	45	19
Lark Bunting (<i>Calamospiza melanocorys</i>)	28	12
McCown's Longspur (<i>Calcarius mccownii</i>)	13	5
Brewer's Sparrow (<i>Spizella breweri</i>)	4	2
Pinyon Jay (<i>Gymnorhinus cyanocephalus</i>)	2	1
Brewer's Blackbird (<i>Euphagus cyanocephalus</i>)	1	<1
Northern Flicker (<i>Colaptes auratus</i>)	remains*	<1
Anseriform spp.	remains	<1
Mollusks		
Gastropoda spp.	1	<1

* Remains found in eyrie.

cons would attempt to surprise prey by flying approximately 6 m off the ground while traveling rapidly down draws. Falcons using fast, contour-hugging flights have been noted by other researchers (Webster 1944; Dunstan et al. 1978). Foraging falcons were also observed “still hunting” from fence posts, telephone poles, and high-tension power poles.

On 16 June 1984, a male falcon was observed hunting Cliff Swallows (*Hirundo pyrrhonota*). He flew rapidly along a cliff face in an apparent effort to

capture swallows leaving their nests. On several occasions, the falcon hung upside from the Cliff Swallow nests while reaching inside, presumably to extract nesting swallows or their young. The falcon was unsuccessful though persistent in capturing swallows during these observations, however which suggests that the foraging technique must at times be successful.

A single case of kleptoparasitism was observed when a male falcon forced a Northern Harrier (*Circus cyaneus*) to drop a mouse which the falcon retrieved. Both the methods of hunting cliff swallows and prey piracy from a Northern Harrier were also documented by Holthuijzen et al. (1987).

Prey Abundance Indices—Passerine Birds. Fifteen species of birds were observed on bird transects (Table 3). Lark Buntings, Brewer's Sparrows, Horned Larks, and Vesper Sparrows (*Poocetes gramineus*) were present on >75% of all transects suggesting an even distribution on falcon foraging areas. Remaining species were observed infrequently (on ≤13% of the transects).

The *t*-Test statistic was used to test the null hypothesis that both 1984 and 1985 bird transects had equal bird numbers. We failed to accept the null hypothesis (*P* = 0.019) in favor of the alternate hypothesis which suggested that significantly more prey-sized birds were present on falcon foraging areas in 1985 than in 1984.

Prey Abundance Indices—Small Mammals. During 800 trap days and 800 trap nights, a total of 166 small mammals from 3 species were captured (Table 4). A total of 141 Thirteen-lined Ground Squirrels were captured accounting for 85% of total captures. This was the only species captured during day trapping while all 3 species were captured at night. However, 23 Thirteen-lined Ground Squirrels classified as night captures were probably trapped either early morning or late evening and did not represent nocturnal activities for the species (Murie and Michener 1984).

The only species captured on transect 1 located in a grassland habitat was Thirteen-lined Ground Squirrel while all 3 species were captured on the other transects located in mixed grass-sage habitat types (Table 4). The greatest number of small mammals were captured on transect 4 which was located in a similar habitat type as were transects 2 and 3 but in an area of very sandy soil.

The *t*-Test statistic was used to test the null hypothesis that the numbers of small mammals cap-

Table 2. Percent frequency of prey remains found in Prairie Falcon pellets according to year (1982–85), Campbell County, Wyoming.

	1982 (N = 21)	1983 (N = 91)	1984 (N = 57)	1985 (N = 74)	Four Yr. Wt. Ave.
Mammals					
13-lined Ground Squirrel (<i>Spermophilus tridecemlineatus</i>)	95	95	75	97	91
Least Chipmunk (<i>Eutamias minimus</i>)	5	2	7	—*	3
Leporidae spp.	—	7	2	—	6
Mule Deer (<i>Odocoileus hemionus</i>)	—	—	2	—	tr**
Unknown mammal	10	1	—	—	1
Birds					
Western Meadowlark (<i>Sturnella neglecta</i>)	81	66	53	38	56
Horned Lark (<i>Eremophila alpestris</i>)	24	29	26	10	22
Lark Bunting (<i>Calamospiza melanocorys</i>)	14	19	4	11	13
McCown's Longspur (<i>Calcarius mccownii</i>)	19	4	7	3	6
Brewer's Sparrow (<i>Spizella breweri</i>)	—	4	—	—	1
Brewer's Blackbird (<i>Euphagus cyanocephalus</i>)	—	1	—	—	tr
Pinyon Jay (<i>Gymnorhinus cyanocephalus</i>)	—	—	—	3	1
American Kestrel (<i>Falco sparverius</i>)	—	—	2	—	tr
Unknown passerine	—	10	9	43	19
Mollusks					
Gastropoda spp.	—	1	—	—	tr

* Prey item not present.
** tr = trace.

tured in 1984 and 1985 were equal. We failed to reject this hypothesis ($P = 0.785$) suggesting that no significant differences in the number of small mammals were present between years.

DISCUSSION

Prairie Falcons at Pumpkin Butte used Thirteen-lined Ground Squirrels as their primary prey species during the nesting season. Thirteen-lined Ground Squirrel litters emerge from their burrows in mid-June (Streubel and Fitzgerald 1978) making them highly available to foraging falcons.

Ninety-three percent of pellets contained some feather remains indicating these falcons frequently foraged on birds. Other studies have documented similar high use of avian prey by nesting Prairie Falcons (Marti and Braun 1975; Denton 1975; Peterson et al. 1977; Voilker, unpublished data cited in Sherrod 1978; Becker 1979). However, MacLaren (1986) found that pellets from Prairie Falcons in southeastern Wyoming were dominated by mammalian prey (86.3%) with only 13.7% containing avian remains.

Western Meadowlarks were the primary avian

prey found in 56% of the pellets in our study. However, meadowlarks were not the most common prey-sized bird present on the study area according to our bird transects. Prairie Falcons may actively select meadowlarks, even though other avian prey were more abundant. Other researchers have also noted a similar high incidence of meadowlark in Prairie Falcon diets (Fowler 1931; Enderson 1962; Leedy 1969; Platt 1974; Denton 1975; Becker 1979).

Two pellets contained unusual prey remains for Prairie Falcons. One pellet was composed entirely of Mule Deer (*Odocoileus hemionus*) hair. There are at least 2 possible explanations for such an occurrence. The falcon either fed on deer carrion directly or consumed the stomach of a carrion feeding bird (i.e., Pinyon Jay (*Gymnorhinus cyanocephalus*), Clark's Nutcracker (*Nucifraga columbiana*), Brewer's Blackbird (*Euphagus cyanocephalus*)). The first explanation was thought more probable since the pellet did not contain any feather remains. To our knowledge, this is the first documentation of Prairie Falcons possibly consuming carrion.

The second unusual pellet was composed entirely of aquatic snail shells with no trace of feather or fur

Table 3. Abundance and distribution of birds observed on 6 strip transects of 1.6 km each.

SPECIES	NUMBER OBSERVED	PERCENT- AGE OF TRAN- SECTS ON WHICH SPECIES WERE OBSERVED
Lark Bunting (<i>Calamospiza melanocorys</i>)	284	88
Brewer's Sparrow (<i>Spizella breweri</i>)	176	83
Horned Lark (<i>Eremophila alpestris</i>)	174	71
Vesper Sparrow (<i>Pooecetes gramineus</i>)	133	75
Mourning Dove (<i>Zenaida macroura</i>)	66	25
Cliff Swallow (<i>Petrochelidon pyrrhonota</i>)	47	8
McCown's Longspur (<i>Calcarius mccownii</i>)	43	13
Brewer's Blackbird (<i>Euphagus cyanocephalus</i>)	22	13
Western Meadowlark (<i>Sturnella neglecta</i>)	14	25
Lark Sparrow (<i>Chondestes grammacus</i>)	6	13
Sage Thrasher (<i>Oreoscoptes montanus</i>)	2	4
Common Night-hawk (<i>Chordeiles minor</i>)	2	4
Chestnut-collared Longspur (<i>Calcarius ornatus</i>)	2	4
Red-winged Blackbird (<i>Agelaius phoeniceus</i>)	2	4
Killdeer (<i>Charadrius vociferus</i>)	1	4

remains. It is difficult to envision how a Prairie Falcon would encounter snails while foraging. Possibly, the falcon ate the stomach of an aquatic-feeding bird (Killdeer (*Charadrius vociferus*) or waterfowl) which contained the shells, but no feather remains were present in the pellet. The falcon might have selectively picked snails from aquatic vegetation while drinking or bathing. Other species of birds do consume snails with shells to help meet their calcium requirements (Krapu and Swanson 1975; Beasom

Table 4. The number of small mammals captured on live-trap transects during 1984–85, Campbell County, Wyoming.

TRAN- SECT NUMBER (YEAR)	THIRTEEN- LINED GROUND SQUIRREL		DEER MOUSE		GRASS- HOPPER MOUSE	
	DAY	NIGHT	DAY	NIGHT	DAY	NIGHT
1-(1984)	9	0	0	0	0	0
1-(1985)	14	2	0	0	0	0
2-(1984)	8	0	0	4	0	0
2-(1985)	11	5	0	7	0	1
3-(1984)	2	0	0	0	0	0
3-(1985)	2	1	0	2	0	1
4-(1984)	39	6	0	2	0	5
4-(1985)	33	9	0	1	0	2
Total	118	23	0	16	0	9

and Patte 1978; Ankney and Scott 1980). It is possible that Prairie Falcons also consume snails to compensate for calcium deficiencies incurred during egg production.

In summary, Prairie Falcons at Pumpkin Butte foraged on a diversity of prey that included at least 15 species. However, 4 species, Thirteen-lined Ground Squirrel, Western Meadowlark, Horned Lark, and Lark Bunting comprised the bulk of the diet. Most pellets (93%) contained feather remains suggesting that falcons frequently foraged on avian prey.

ACKNOWLEDGMENTS

This project was funded by the Wyoming Game and Fish Department with assistance from the Wyoming Cooperative Fish and Wildlife Research Unit. J. Depperschmidt, S. Irvine, and M. Fowler provided valuable assistance with field data collections.

LITERATURE CITED

ANKNEY, C. D. AND D. M. SCOTT. 1980. Changes in nutrient reserves and diet of breeding Brown-headed Cowbirds. *Auk* 97:684–696.

BEASOM, S. L. AND O. H. PATTE. 1978. Utilization of snails by Rio Grande Turkey hens. *J. Wildl. Manage.* 42:916–919.

BECKER, D. M. 1979. A survey of raptors on national forest land in Carter County, Montana. U.S. Dept. of Agriculture, Forest Service, Final Progress Rept. 1977–79. 61 pp.

BOYCE, D. A., JR. 1985. Prairie Falcon prey in the Mohave desert, California. *Raptor Res.* 19:128–134.

CRAIGHEAD, J. J. AND F. C. CRAIGHEAD JR. 1956.

- Hawks, owls and wildlife. The Stackpole Co., Harrisburg, Pa. and the Wildlife Management Institute, Washington, DC. 443 pp.
- DENTON, S. J. 1975. Status of Prairie Falcons breeding in Oregon. M.S. Thesis, Oregon State University, OR. 58 pp.
- DUNSTAN, T. C., J. H. HARPER AND K. B. PHIPPS. 1978. Habitat use and hunting strategies of Prairie Falcons, Red-tailed hawks, and Golden Eagles. U.S.D.I. Bureau of Land Management contract 52500-CT5-1013. 177 pp.
- ENDERSON, J. H. 1962. Ecology of the Prairie Falcon (*Falco mexicanus schlegel*) in the central Rocky Mountain Region. Ph.D. Thesis, University of Wyoming. 87 pp.
- FOWLER, F. H. 1931. Studies of the food and growth of the Prairie Falcon. *Condor* 33(5):193-201.
- HOLTHUIJZEN, A. M. A., P. A. DULEY, J. C. HAGER, S. A. SMITH AND K. N. WOOD. 1987. Piracy, insectivory and cannibalism of Prairie Falcons (*Falco mexicanus*) nesting in southwestern Idaho. *J. Raptor Res.* 21(1): 32-33.
- KRAPU, G. L. AND G. A. SWANSON. 1975. Some nutritional aspects of reproduction in prairie nesting Pintails. *J. Wildl. Manage.* 39:156-162.
- LEEDY, R. R. 1969. The status of the Prairie Falcon in western Montana: special emphasis on possible effects of chlorinated hydrocarbon insecticides. M.S. Thesis, University of Montana, Missoula. 96 pp.
- MACLAREN, P. A. 1986. Resource partitioning in an assemblage of breeding raptors from southeastern Wyoming. M.S. Thesis, University of Wyoming, Laramie. 64 pp.
- MARTI, C. P. AND C. E. BRAUN. 1975. Use of tundra habitats by Prairie Falcons in Colorado. *Condor* 77(2): 213-214.
- MOORE, T. D., L. E. SPENCE, G. E. DUGNOLLE AND W. HEPWORTH. 1974. Identification of the dorsal guard hairs of some mammals of Wyoming. Wyoming Game and Fish Dept., Cheyenne. 177 pp.
- MURIE, J. O. AND G. R. MICHENER. 1984. The biology of ground-dwelling squirrels. University of Nebraska Press, Lincoln and London. 459 pp.
- NIE, J. H., C. H. HULL, J. G. JENKINS, K. STEINBRENNER AND D. H. BENT. 1975. Statistical package for the social sciences. McGraw-Hill Book Co., New York. 675 pp.
- OGDEN, V. T. AND M. G. HORNOCKER. 1977. Nesting density and success of Prairie Falcons in southwestern Idaho. *J. Wildl. Manage.* 41:1-11.
- PETERSON, S. R., G. M. SITTER AND B. W. JAMES. 1977. Feeding activity and behavior of Prairie Falcons. Pages 165-177. In Snake River Birds of Prey Research Prog. Annual Report 1977. U.S. Dept. of Interior, Bureau of Land Management, Boise, ID. 201 pp.
- PLATT, S. W. 1974. Breeding status and distribution of the Prairie Falcon in northern New Mexico. M.S. thesis, Oklahoma St. Univ., Stillwater. 69 pp.
- PORTER, R. D., C. M. WHITE AND R. J. ERWIN. 1973. The Peregrine Falcon in Utah, emphasizing ecology and competition with the Prairie Falcon. *Brig. Young Univ. Sci. Bull.* 18:1-74.
- SHERROD, S. K. 1978. Diets of North American falconiformes. *Raptor Research* 12(3/4):49-121.
- STREUBEL, D. P. AND J. P. FITZGERALD. 1978. *Spermophilus tridecemlineatus*. *Mammal. Species* 103:1-5.
- WAYRE, P. AND G. F. JOLLY. 1958. Notes on the breeding of the Iceland Gyr falcon. *Brit. Birds* 51:285-290.
- WEBSTER, H. JR. 1944. A survey of the Prairie Falcon in Colorado. *Auk* 61:609-616.
- Wyoming Cooperative Fish and Wildlife Research Unit,
P.O. Box 3166 University Station, Laramie, WY
82071. Address of third author: Wyoming Game
and Fish Dept. 260, Buena Vista, Lander, WY 82520.**

Received 27 February 1989; accepted 15 December 1989